PLANT IMPROVEMENT & SEED PRODUCTION

PROJECT

ANNUAL REPORT FOR 1997

Activity Report for the Steering Committee Meeting n° 9

(March 1998)

ICSB / CIRAD-Forêt

Plant Improvement and Seed Production Project, CIRAD-Foret / ICSB

Study of the Heart Rot Disease on Acacias species by Tree Core Sampling

Philippe Pajon and Roberto Bacilieri [1] ,1998

Introduction

Acacia mangium and other closely related *Acacia* species have recently gained in importance in the reforestation programmes of humid tropics of South-East Asia. The trees are planted mainly for pulpwood production, however they may be suitable for panel production and in some cases they can be used as sawn timber (construction and even furnitures).

One of the main problems of these *Acacias* species group is the heartrot disease, that attacks the centre of the trunk, sometime on almost the whole length (Ibrahim *et al.*, 1994). The loss in volume can be important, especially if the final product is sawn timber.

In the present paper, we studied the incidence and variation of the heart rot disease on the two more promising *Acacias* species used in the Luasong Forestry Centre: *A. mangium* and *A. auriculiformis*. The availability of 6-year-old progeny trials in Luasong allowed us to apportion the variation of the disease among the genetic differences between provenances and families, and the environment (blocks).

Material and methods

The heart rot incidence has been studied on three Acacia progeny trials:

- *Acacia mangium*, origin Papua New Guinea (PNG), trial SSO1
- *Acacia mangium*, origin Papua New Guinea, trial SSO2
- *Acacia auriculiformis*, origin Papua New Guinea and Queensland (QLD), trial SSO1

These progeny trials were planted in February 1990 in Tiagau, Luasong; the core sampling was done in July 1996. The initial planting density was 2.5 * 3 meters (1333 trees / ha). Three thinnings have been carried out:

- October 1991: 3 out of 5 trees thinned
- January 1992: 1 tree out of 2 thinned
- February 1996: some of the worse families were thinned (5% of the trees)

[1] CIRAD/Foret/ICSB, PISP, Luasong. Po Box 60793, 91017 Tawau, Sabah, Malaysia

The thinning were always selectives (thinning of the worse trees) and quite intensive in order to induce an abundant flowering for seed production. The characteristics of the trials at the moment of the study are summarised in the following table:

	Number of Families	Number of trees per family	Number of different geographic origins
A. mangium PNG, SSO1	56	6	15
A. mangium PNG, SSO2	46	6	15
A. auriculiformis PNG & QLD, SSO1	52	4	8

Each of the trees of these trials was sampled with an increment borer, 1 meter above the soil level. At the same height, we measured the diameter of the stem at the position of the core holes. Then, in order to calculate the portion of the trunk diameter infected by the disease we applyed the following formula:

$$\textit{Rot note} = \frac{\textit{Length of the sample infected by the heart rot}}{\textit{Diameter}}$$

The rot note data were first studied by using an analysis of variance. However, the distribution of the variable was far from the normal, even after a arcsin transformation. For this reason, we also studied the variable by using non parametric statistics (SAS, 1996).

Results

A. mangium seems much more sensitive to the disease than *A. auriculiformis*: 36% of the *A. mangium* trees were infected compared to 8% in *A. auriculiformis*. For the contaminated trees, the proportion of roted wood is also less important for *A. auriculiformis*: only 10% compared to 16% in *A. mangium*.

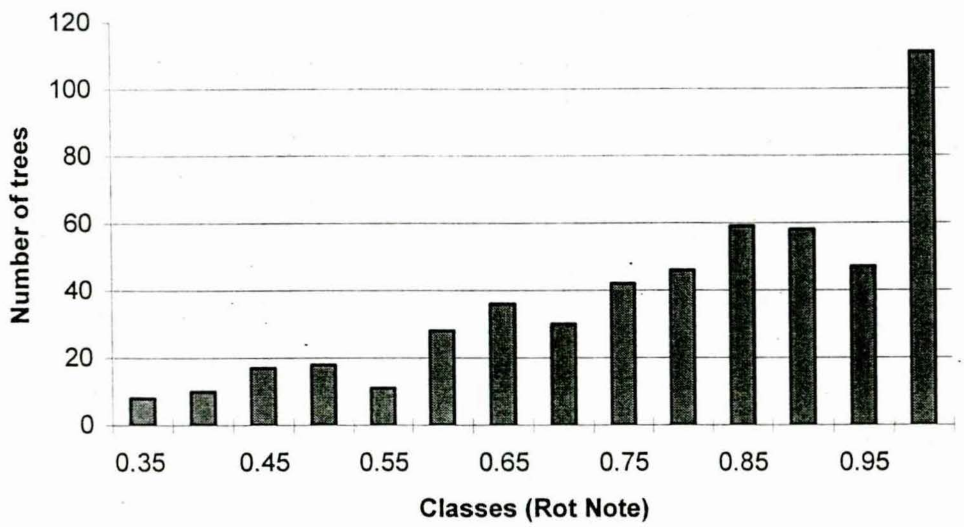
TABLE 1. Summary of the heartrot attack data on two Acacia species.

	Number of sampled trees	*Number of infected trees*	*Percentage of infected trees*	*Portion of wood damaged by the heart rot (calculated only on the infected trees)*
A. mangium PNG, SSO1 and SSO2	310	111	36%	16 %
A. auriculiformis PNG & QLD, SSO1	208	16	8%	10 %

In *A. auriculiformis*, the incidence of the disease was low; a study of the distribution of the attacks within and between treatments (blocks, provenances and families) was not possible because of the low number of attacked trees.

For *A. mangium*, a preliminary study of the heartrot variable showed that its distribution was far from normal (Figure 1). The ordinary analysis of variance in not the most appropriated method to be used in this context as one of its main assumption, the normality of the variable distribution, is violated; it can however give hints on the partition of the variation between effects (in this case trials, blocks within trials, provenances and families within provenances). To study the differences of the heart rot incidence with more precision we also used a non-parametric test (Kruskal-Wallis, SAS, 1988).

Figure 1. Distribution of the heartrot values over the two A. mangium trials, SSO1 and SSO2



The analysis of variance (Table 2), where the trial and block effects were slightly and very significant respectively, showed that probably a site effect played a role in the distribution of the disease. By contrast, it was not possible to evidence any genetic effect (neither from provenances nor from families). This result was confirmed by a non-parametric test (Kruskal-Wallis), that even if less detailed is to be considered more precise in this case (Table 3).

TABLE 2. Analysis of variance of the incidence of the heart rot disease over the two Acacia trials (SSO1 and SSO2).

Dependent Variable: Rot Note

Source	*DF*	*Sum of squares*	*Mean square*	*F Value*	*Pr > F*
Model	49	0.569	0.0116	1.01	0.4679
Error	221	2.548	0.0115	--	--
Trials	1	0.038	0.038	3.33	0.0696
Blocks(Trial)	6	0.205	0.034	2.95	0.0084
Provenances	10	0.053	0.005	0.46	0.9137
Families(Prov)	32	0.279	0.009	0.76	0.8252

TABLE 3. Non-parametric tests (Kruskal-Wallis) of the differences of the heartrot incidence between treatments (trial, blocks, provenances, families), for *A. mangium* in the Tiagau's trials SS01 and SS02.

Level	*Number of trees*	χ^2	*DF*	$Pr>\chi^2$
Trial	271	0.0325	1	0.8567
Block	271	16.167	7	0.0235
Provenance	271	4.5506	10	0.9191
Family	271	34.666	41	0.7468

In Table 4, the ranking of the blocks according to the weight of the disease attack is shown and tested by a Duncan test. The ranking being significant (in particular the difference among blocks 2 and 5 in trial SSO2), there remains to study which are the most important environment factors affecting the disease's distribution. On the other hand, the Duncan's test of ranking confirmed that the differences among families were not significant (not shown).

TABLE 4. Average and ranking of the variable RotNote in the two trials, SSO1 and SSO2, and in the blocks within the trials. Duncan test of the ranking.

Treatment	*Number of trees*	*Mean*	*Critical Range*	*Duncan Grouping (Trial / Block)*
SSO1	**105**	**0.955**	**0.0263**	**A**
Block 3	31	0.963	0.034	A
Block 1	38	0.960	0.036	A
Block 2	36	0.942	--	A
SSO2	**166**	**0.935**	**0.0263**	**A**
Block 5	35	0.985	0.059	A
Block 3	38	0.958	0.062	A B
Block 1	34	0.925	0.064	A B C
Block 4	28	0.906	0.065	B C
Block 2	31	0.891	--	C

NOTE: Duncan test: means with the same letters are not significantly different

Conclusion

Conclusion of this study can be summarized as follows:

- It was not possible to find any difference among families or provenances in terms of sensitivity to the heartrot attacks. It is probably not worth to include the character "resistance to the heartrot disease" as a selection criterium.
- In one of the two trials, a site effect was present. It may be due to differences among blocks in soil humidity, in the previous pattern of distribution of the fungus, or simply to chance. This result contrasts with the study of Brahim *et al.* (1994), which failed to find a site effect even with a large scale sampling. A more detailed study of this effect can be conducted on the large scale Sabah Softwood's plantation.

LITERATURE

Ibrahim Z., Wan Razali W.M., Hashim M.N., Lee S.S., 1994. The incidence of heartrot in Acacia mangium plantation in Peninsular Malaysia. FRIM Research Pamphlet, 114:1-15.

SAS Institute Inc., 1988 SAS/STAT User's Guide, Release 6.03 Edition. Cary, NC, 1028 pp.